dangerous mode (from the failure of any one of the delicate manipulations introduced) for *one analysis*, will probably arrive in the end, at a result more closely approaching to the truth.

Blowpipe Assay of Ores, Furnace Products, &c., for COBALT.

1. The *rationale* of this process depends upon the observations (*a*), that a trace (say ·5 mgr.) of cobalt oxide affords, when dissolved in a bead of microcosmic salt, *the same* colour (violetish blue) which is afforded by the addition to a similar bead of *five times* as much oxide, or 2·5 mgr-. ; and (*b*) that these relative quantities of cobalt oxide afford, when dissolved in *phosphoric acid* beads of the same weight (say 60 mgrs.), *perfectly different* colours ; viz., *pink* as regards the smaller proportion, *violet* as regards the greater.

2. The corollary derivable from these premises seemed to me, therefore, that, the quantity of phosphoric acid being kept constant, it would require the addition of more *soda* to turn the pink bead than the violet bead *blue*; first, because violet already contains blue, and second, because the cobalt might be presumed to have already saturated, as a chemical base, part of the phosphoric acid.

3. I was *exactly wrong* in this assumption. Different quantities of soda were, indeed, required to azurise the two beads, but the *violet* bead required *more* than the pink one.

4. Without troubling the reader with tedious details, I may state here that each of three assays constantly showed the necessity of an addition of 14 mgrs. of fused sodium carbonate in order to azurise a 60-mgrs. bead of phosphoric acid, made pink by the solution in it of ·5 mgr. of pure cobalt oxide ; and (by three other assays) an addition of 20 mgrs. of soda to azurise a 60 mgrs. bead made violet by 3·5 mgrs. of cobalt oxide. The ratio, therefore, stood thus :—

$\dddot{N}aC$		$\dddot{N}aC$		CoO		CoO
20	:	14	::	3·5	:	·5

or the violet standard of cobalt was to the pink standard, as 2·45 : 0·71. It would, by these assays, seem that every half milligramme between those extremes of cobalt oxide dissolved, requires the addition to the bead of one milligramme of fused sodium carbonate, in order to azurise a 60 mgrs. bead of pure phosphoric acid.

5. The way to operate is to compare, by reflected and transmitted light, the blue colour thus obtained, with that of two 60 mgrs. beads of *microcosmic salt*, having the above-named quantities of pure cobalt oxide respectively dissolved in them. Space does not allow me here to describe the *mechanical details* of operations, which must be conducted with the utmost care.

6. From these facts, the following analytical table, as regards *cobalt*, is deduced :—

CoO mgrs.		$NaCo_3$ mgrs.			
0·5	requires	14	= 0·83	per cent. of a 60 mgrs. phosphoric acid bead.	
1·0	,,	15	= 1·6	,,	,,
1·5	,,	16	= 2·5	,,	,,
2·0	,,	17	= 3·3	,,	,,
2·5	,,	18	= 4·1	,,	,,
3·0	,,	19	= 5·0	,,	,,
3·5	,,	20	= 5·8	,,	,,

The use of this table is shown in the following example :—

7. *Assay (for Cobalt only) of Smaltine, from a Freiberg Cabinet.*

		mgrs.	per cent.
α.	Weight of powdered ore crushed between agates ... ... =	50	—
β.	Weight of powdered ore after roasting on aluminium plate... ... ... =	18	36
	Therefore the loss in arsenic and volatile constituents ... ... =	32	64
γ.	Weight of a new platinum wire with a ring of 1 diameter[1] ... ... =	71·5	—
δ.	Weight of the same platinum wire with a bead of phosphoric acid fused on it =	134·5	—
ε.	Weight of the bead and wire after 2·5 mgrs. of (*β*) had been dissolved in the former ... ... =	124·0	—

[1] This refers to the "ringing forceps."

		mgrs.	per cent.
ζ.	Weight of the bead and wire after the addition of fresh phosphoric acid[1] ... ... =	132·5	—

(This bead being *rose* colour,[2] *fused sodium carbonate* was cautiously taken up from an agate slab and dissolved in it under O.P.).

η.	Weight of soda required to colour to the *blue* of mic. salt with 2·5 CoO... =	16·5	—

Now, by the above table (6), 16·5 mgrs. of *soda* correspond to 3 per cent. of a 60 mgrs. bead in *pure* CoO ; and 2·5 mgrs. of pure CoO, requiring 18 mgrs. of soda, constitute 4·1 per cent. of the bead. Therefore we have the ratio—

4·1 : 3 :: 100 = $\frac{3}{4\cdot1}$ths of 100 = 75 per cent.

But, as this is the percentage of the *roasted powder*, or "regulus," we have—

Regulus in 100 mgrs.		Percentage of regulus. mgrs.		Mgrs. of ore.
36	:	75	::	100 = 20·08 per cent. cobalt.

Several assays were made with a similar result, but one other example is given here, with a different platinum wire.

			mgrs.
α.	Weight of a platinum wire ... ... =		61·0
β.	,,	ditto with bead of phosphoric acid =	131 0
γ.	,,	roasted *smaltine* dissolved in (*β*). =	2·5
δ.	,,	this wire with bead coloured rose pink with (*γ*) ... ... =	118·5
ε.	,,	bead and wire with fresh phosphoric acid ... ... =	121·0
ζ.	,,	sodium carbonate required to colour (*ε*) *blue* ... ... =	16·5

8. These data would, of course, give a similar result. Roasting before O.P. on *aluminium plate* is so rapid and efficacious that the whole process only occupies about half an hour ; with the *roasted powder*, about a quarter of an hour. A drop of water is placed on the powder to retain it under the blast.

In roasting, *nickel* oxide appears, yellowish green, on the surface, and might possibly be mechanically separated at this stage of the procedure.

W. A. ROSS

[1] This is necessary to make up the weight of the bead to 60 mgrs. After the addition of soda, there is *no* loss from volatilisation.

[2] From the interference of iron and nickel oxides in the assay.

Page's Introductory Text-book of Physical Geography

IT has been pointed out to me that the same errors which I noted in this book (NATURE, vol. xiv. p. 26), had been corrected as regards Prof. Page's "Advanced Text-book" by Mr. Wallace three years ago. They can scarcely, therefore, be anything but wilful, and it is difficult to understand how they could be allowed to reappear. We do expect teachers of position at least to do their best to teach rightly ; and when one has fallen into error it is certainly more manly to correct it than to stick to it, because it has once been committed. It is a good thing to teach science, but it is just the opposite deliberately to teach false science.

THE REVIEWER

OUR ASTRONOMICAL COLUMN

THE SECONDARY LIGHT OF VENUS.—By way of supplement to the historical notes on the luminosity of the "dark side" of the planet Venus in last week's "Astronomical Column," a brief enumeration of the various explanations of the phenomenon which have been offered from time to time may not be out of place here.

These resolve themselves into (1) reflected earth-light analogous to the lumière-cendrée exhibited by our moon, an explanation advanced by Schröter, Harding, and many others ; (2) phosphorescence of the planet's atmosphere, suggested by Sir W. Herschel to account for the appearances remarked by Schröter, though looked for without success by himself, with which may be mentioned Pastorff's idea of a self-luminous atmosphere ; (3) visibility by contrast—"might not a plausible explanation be given," asks Arago, "by referring it to a class of objects which are negatively visible, or which are rendered apparent by way of contrast?" (4) luminosity, similar to our polar-light (aurora borealis) ; (5) natural light-developments, as luminosity of the ocean ; (6) a condition of

glowing-fire, or intense heat of the surface; and (7) the *Künstliche Feuer* of Gruithuisen.

There is one characteristic of the phenomenon abundantly verified by the numerous observers who have recorded it, which cannot be overlooked in our endeavours to arrive at its true cause, viz., its intermittent or only occasional visibility. This alone appears to render more than one of the explanations which have been advanced highly improbable if not wholly inadmissible. There are also isolated observations which seem rather to favour one or other of the hypotheses. Thus Schröter considered that the change in the colour of the faintly illuminated disc from reddish to ashy-grey remarked by Harding, indicated a connection with our aurora borealis, in exhibitions of which similar rapid changes or alternations of colour are observed, and a very curious observation by Mädler has been cited in the same direction. On April 7, 1833, at 8 P.M., in a sky of extraordinary clearness and tranquillity, Venus, then in crescent-phase, appeared to him accompanied by a beautiful radiating appearance; seven or eight straight rays, at times very bright and sharply defined, at others fainter and more diffused, occupied the north-west quadrant, and were gradually lost in the general ground of the sky. The longest ray extended about 15′, the shortest was about half that length; neither turning round the eye-piece, nor viewing the planet in different parts of the field of the telescope, at all affected the phenomenon, which continued unchanged as long as Venus was observed that evening. A figure of this appearance is attached to Mädler's account of his observation.

Zöllner has expressed his conviction that under spectroscopic examination, the ash-coloured secondary light of Venus will be found to present bright lines, and it may be hoped that opportunities for such observations may occur during the present summer.

By closely watching the form of the crescent towards the extremities, further evidence of rotation in rather less time than is occupied by the earth in her diurnal revolution, may also be obtained. But with this object, observations must be made at very short intervals. In illustration of this may be quoted Mädler's experiences on June 6 and 10, 1836.

	h. m.	
June 6,	10 41	Sid. T. Both horns equally pointed, and the curvature quite elliptical.
,,	11 10	,, The same.
,,	11 36	,, The northern horn appears to be the more pointed.
,,	11 38	,, The northern horn certainly more pointed: also at 11h. 43m.
,,	11 56	,, Again uncertain.
June 10,	11 14	,, Both horns alike.
,,	11 26	,, The northern is more pointed.
,,	11 38	,, Again doubtful.

Mädler referring to these and other observations of a similar character, in May and June 1836, expresses his opinion that they are quite irreconcilable with Bianchini's period of rotation, but may be compatible with the shorter one of Cassini and Schröter.

THE MINOR PLANETS.—The following summary is founded upon elements of 153 members of this group, which appear to be sufficiently well determined to afford reliable results. It exhibits the distribution of the perihelia, nodes, inclinations, and excentricities, and will be seen to offer several very decided characteristics.

1. *Longitudes of the Perihelia.*

° °	Number of Orbits.	° °	Number of Orbits.
0– 30	18	180–210	7
30– 60	22	210–240	9
60– 90	11	240–270	10
90–120	15	270–300	7
120–150	12	300–330	19
150–180	7	300–360	16

2. *Longitudes of the Ascending Nodes.*

° °	Number of Orbits.	° °	Number of Orbits.
0– 30	15	180–210	19
30– 60	13	210–240	8
60– 90	19	240–270	5
90–120	6	270–300	7
120–150	16	300–330	13
150–180	16	330–360	16

3. *Inclinations to the Ecliptic.*

°		°	
0– 5	52	20–25	6
5–10	58	25–30	2
10–15	26	30–35	1
15–20	8		

4. *Excentricities.*

0·00–0·05	7	0·20–0·25	31
0·05–0·10	23	0·25–0·30	6
0·10–0·15	41	0·30–0·35	6
0·15–0·20	38	0 35–0·40	1

A FREE SPANISH UNIVERSITY

OUR readers will easily understand what sort of a foster-mother a Government like that of Spain will prove to education generally, and to scientific education and inquiry in particular. Any educational institution connected with such a state must necessarily be hampered and hindered in many ways, and the only chance of obtaining perfect liberty in scientific education and instruction is in being rid of all state interference. This has been so strongly felt in Spain by some of the foremost Spanish men of science and letters that they have formed an association to found an institution for free education. A prospectus of the institution has been forwarded us, and the difficulties which beset a liberal education in Spain may be learned from the fact that it is signed by ten ex-professors of the highest standing, all of whom have been removed from their chairs by Government on account of their liberal opinions. Among these are the names of Augusto G. de Linares, ex-Professor of Natural History at the University of Santiago, and Laureano Calderon, ex-Professor of Organic Chemistry at the same University. The object of the Association, as stated in the prospectus, is to found at Madrid a free institution dedicated to the culture and propagation of science in its various branches, specially by means of education. A sort of joint-stock company will be constituted by shares of 250 francs, payable in four instalments between July next and April 1877. A preliminary meeting was to be held on the 1st inst. to constitute the Society, and we earnestly hope that a successful start has been made. The Association will be directed by a Council representing all parties interested. The Institution itself will, of course, be perfectly free from all religious, philosophical, or political restrictions, its only principles being the "inviolability of science" and the perfect liberty of teaching. There will be established, according to the circumstances and means of the Society (1) studies for general, secondary, and professional education with the academic advantages accorded by the laws of the State; (2) superior scientific studies; (3) lectures and brief courses, both scientific and popular; (4) competitions, prizes, publication of books and reviews, &c. The greatest precautions will be taken to obtain as professors men of undoubted probity and earnestness and of the highest competence.

We need say nothing to our readers in recommendation of the above scheme. All who sincerely desire the welfare of Spain and the spread of scientific knowledge must sympathise with its promoters, who, we have every reason to believe, are men of the highest character and competency. We hope that not a few of our readers will show their sympathy with the object of the Association by sending the moderate subscription which constitutes a shareholder to M. Laureano Figuerola, Calle de Alcalá, 72, Madrid.